PI MU EPSILON JOURNAL

THE OFFICIAL PUBLICATION OF

THE HONORARY MATHEMATICAL FRATERNITY

VOLUME 1 NUMBER 3

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NOVEMBER 1950

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OF THE HONORARY MATHEMATICAL FRATERNITY

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NOVEMBER 1950

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LETTER FROM THE DIRECTOR GENERAL

Dear fellow members of Pi Mu Epsilon:

The fraternity begins another year under a slightly modified constitution, for six of the proposed amendments which were submitted to the chapters last year were approved. The only one which failed of approval was Proposal V, which would have required the Director to be a member of the faculty.

The purpose of the Councillors in making Proposal V was evidently not clear to the chapters, some of whom assumed that the proposal would take the management of the chapter out of the hands of the students. A little investigation now shows that Section 2 of Article VI of the constitution has been variously interpreted by the different chapters. Many chapters have a President, Secretary and Treasurer picked from among the students, while the Director is a faculty member who serves merely as a Faculty Adviser. This is the organization which Proposal V would have made standard. But many of our chapters have a Director, Vice-Director, Secretary and Treasurer, all of whom are students. If Proposal V had passed, it would have required such chapters to adopt the first type of chapter organization. It is scarcely conceivable that these chapters do not already have Faculty Advisers, for almost all colleges and universities require that every campus organization have a faculty sponsor. In other words, it was merely a matter of titles.

But the other six proposals, which were the important ones, were all accepted by the chapters. The first three were necessary to implement the Journal, and their acceptance constitutes approval by the chapters of the establishment of the Journal. Long may it prosper! There are still problems concerned with the financing of the Journal which

remain to be worked out, but with the support of the members these will be solved so that the cost of the Journal will remain minimal.

Proposal VII is an important one in that it clarifies and codifies the standards for admission, but actually it does not change present practice in a material way. It was the belief of the Council that the constitution laid undue stress on whether an institution called itself a university or a college, and the amendment allows the Council to judge a petitioning group on a more significant basis.

The year ahead of us will present many problems, but with courage and clear vision we shall continue to advance the cause of Mathematics in American institutions of learning.

Sincerely yours,

C. C. MacDuffee
Director General

WHY STUDY MATHEMATICS?

by Norman Miller*
Queen's University

(1) A belief in the value and importance of mathematics in the modern world;

(2) A belief that greater efficiency in the learning and teaching of the subject would result from a clearer understanding of its vocational uses and of its cultural values.

These headings from the introduction to a pamphlet "Why Study Mathematics?" indicate the point of view of the authors, Committee appointed in 1945 by the Canadian Mathematical Congress. This pamphlet, of which the present article is a condensation, is designed primarily for distribution to high school teachers of mathematics and vocational guidance, through whom it is hoped that the information will percolate to the students who are facing the important question of their choice of a career.

For students with a keen interest in the subject, a survey is made of those professions which draw heavily on mathematics. For students looking to professions less mathematical, an appraisal is made of the contribution which mathematics can make to their training. For students who will make little explicit use of mathematics, the subject nevertheless furnishes the basis for an appreciation of the scientific age in which we live. Finally, for all students, mathematics, taught for its human values, is a means of enlarging their mental and cultural horizons.

*A condensation of a pamphlet published by the Canadian Mathematical Congress and prepared by Professor Miller and others.

CAREERS WHICH REQUIRE AN EXPERT KNOWLEDGE OF MATHEMATICS

Research and teaching in mathematics

To young people today it is more obvious than in a previous generation that mathematics is necessary for many different kinds of positions in our modern society. Only a few years ago thousands of recruits in the armed services discovered that a basic knowledge of mathematics was required of them. Partly as a result of this, thousands of veterans chose to embark upon courses in which mathematics is a prime requirement.

One of the important lessons of history is that much of human progress has been associated with the discovery of new knowledge. Every day we see evidence that this process is still going on, as witness, for example, the efforts put forth to discover the cause and cure of baffling diseases.

It may not be so widely known that discoveries in mathematics are keeping pace with those in other fields. Far from being a dead or "finished" subject, mathematics is active and growing as rapidly as at any previous period in history. Scores of mathematical journals are published throughout the world for the purpose of making known the new discoveries. The subject has become so vast that each mathematician has to be content to specialize in some branch of the subject.

Research in mathematics proceeds from two incentives. In the first place, a mathematician, absorbed in his subject, may regard it simply as a creation of the mind, without concerning himself with possible applications of his work outside of mathematics. Such activity is often designated pure mathematics. The contrasting term, applied mathematics, suggests a slightly different point of view. The applied mathematician is concerned with adapting mathematics to the solution of problems in other subjects or with developing new mathematical theory for this purpose.

From whichever source his interest in mathematics arises, the mathematician arrives at new results by a combination of imagination, intuition, and logic. A flash of insight may be the genesis of his idea, which then requires

patient elaboration with careful logic and with attention to the results of other workers in the field. The flashes of insight, it is hardly necessary to add, are likely to be the fruit of long study and reflection on the problem in hand.

Most of the research in mathematics is carried on by members of the staffs of universities, who fill a dual role in teaching and research. Increasingly, however, industrial corporations and departments of the government are establishing scientific research laboratories in which engineers, scientists, and, in smaller numbers, mathematicians are employed to deal with problems met with in industry.

The extent to which mathematics remains vital and creative will depend largely on the efficiency and enthusiasm of the teachers in the secondary schools and universities. For young men and women with a keen interest in mathematics, a career devoted to informing the minds of the future scientific leaders as well as of other citizens, presents both a challenge and an opportunity for service of a high order.

Physics and Astronomy

Of all the sciences, physics and astronomy are most closely allied to mathematics. Experimentation, observation and mathematical investigation are the methods of the physicist and the astronomer. In some cases the mathematical investigation has been suggested by experimental results as, for example, in the mathematical explanation of the phenomena observed in the refraction of light. In other cases, experiments were devised as a result of mathematical research. A classical example of such research was the formulation of Maxwell's differential equations which, in giving rise to the discovery of electromagnetic waves, contained the germ of such spectacular developments as radio communication, radar, and television.

In astronomy a similar reciprocity holds between observation and mathematical study. The laws of the motion of the planets were formulated by Kepler in advance of their mathematical explanation, which was later supplied by Newton. On the other hand, mathematical calculations have sometimes furnished the inspiration for discoveries in astronomy. It was the calculations of two mathematicians, Adams

and Leverrier, based on the perturbations of Uranus, which indicated the existence and location of the planet Neptune.

A student should consider a career in the field of physics or astronomy only if he finds pleasure in the study of mathematics and science. A student for whom these subjects are a delight will find no more fascinating career and he need never fear that the profession will be overcrowded.

CAREERS WHICH REQUIRE A KNOWLEDGE OF SPECIAL FIELDS OF MATHEMATICS

Engineering

The importance of engineering in a national economy, especially in those areas in which pioneer conditions still prevail, will be apparent to everyone. The development of transportation by land, sea, and air, the harnessing of waterfalls to produce hydro-electric power, the development of natural resources of forest and mine, the design and operation of the machines required by industry, all these require the study and ingenuity of a large number of engineers.

Regarding the training of an engineer, a pamphlet issued by the Engineering Institute of Canada gives this advice:

> "The engineering courses at universities are not easy. It is necessary, therefore, that prospective engineering students should have a thorough preparation at school before entering such courses. They should have a good standing in their classes, especially in mathematics, and should obtain a cultural training which will broaden their outlook and fit them for intelligent citizenship."

Regarding the qualities most desirable in an engineer, we quote from the same pamphlet:

> "A general liking for things related to engineering is, of course, highly desirable. What are some other requirements? A good imagination is one, for engineers have to visualize, and must foresee what is involved in the operation of a proposed plant

or machine. Even more important, however, is a real ability to use mathematics, the engineer's indispensable tool."

Of the attributes of a student from which one could predict success in an engineering career, it is generally agreed that the most outstanding is success in mathematics. It is therefore important for a prospective engineering student to obtain a good foundation in mathematics while in high school. If he finds mathematics difficult or uninteresting, he should not be misled by a fancied interest in gasoline engines or radios into thinking that he would be successful in an engineering course.

Closely related to engineering and requiring much the same preparation in mathematics is architecture. The radical changes in building design which are prevalent today point to the need of this science for a sound basis of mathematical theory.

Chemistry

Among the sciences chemistry may fairly claim to have the widest field of applications. Its evidences are all about us — in plastics, drugs, synthetic foods, cosmetics, and many other things. Most persons have visited one or more plants concerning with the processing of rubber, artificial silk, nylon, paper pulp, pigments, or metals.

Although, as a science, chemistry is not pervaded by mathematics to the same extent as is physics, nevertheless it makes constant use of mathematical techniques and certain branches of the subject require mathematics of an advanced character. Among these one may single out physical chemistry of which the name, suggesting a close relation with physics, implies that mathematics plays a prominent role.

Meteorology

The charting of atmospheric conditions has, in our modern age, become a matter of great importance. The subject of weather "probabilities" has emerged from the realm of

superstition and guessing to that of a science, meteorology, whose prestige is indicated by the fact that no aircraft takes off on a flight of any magnitude without the "all clear" signal from the meteorologist.

Although the development of aviation has been the greatest factor in directing attention to meteorology, its service is by no means confined to aviation. Almost everyone listens to the weather forecasts on his radio. The farmer and gardener are warned regarding early and late frosts, the fisherman regarding the prospect of gales, the lumberman regarding rains, and the forest conservationist regarding continued heat and dry weather.

Since meteorology is an application to atmospheric conditions of the principles of physics and mathematics, a fundamental training in mathematics is a prime requisite for a career in this field.

Statistics

The subject of Statistics has been well named "The Arithmetic of Human Welfare." From crude beginnings a century or so ago, when accurate social records were scarcely possible, this field of mathematics has developed rapidly, particularly since the First Great War.

Most fields of science and public welfare offer opportunities for statistical analysis. The industrial engineer interested in the improvement of the processes of production and distribution uses statistical methods. So do the agricultural and the biological scientists for studies in nutrition and disease, and in plant and animal genetics. Public information polls use technical methods in estimating public opinion. In the outfitting of armies and navies and in the vast number of records that must be kept of their personnel, statistical methods are called for. Public health services make use of statistical data and methods in the control of diseases. Statistical procedures are a standard part of modern research in education.

For able students of mathematics the field of mathematical statistics offers attractive opportunities which are likely to increase in number with the increasing use of modern mathematical procedures. Statisticians are now

employed in business corporations, in large industries, and in various government services.

Actuarial Work

The work of an actuary is in the application of mathematics to problems involving death and survival, and other contingencies. Such problems arise in the theory of insurance, pension funds, and succession duties, and in studies of population growth. This explains why the chief employers of actuaries are the life insurance companies. Governments also have need of the services of actuaries, a need which increases with the introduction of unemployment insurance and other public welfare schemes.

Employers of actuaries report a shortage of well-trained men for this profession. In his apprenticeship period the actuary must expect to engage in much routine calculation. If, however, his interests and his abilities are broad, he may expect promotion to more responsible work. Many of the highest executive positions in insurance companies are held by men who were promoted from the actuarial departments.

CAREERS FOR WHICH MATHEMATICAL TRAINING IS IMPORTANT, THOUGH SUBSIDIARY

For careers in the fields mentioned below the necessary preparation in mathematics is less extensive than for those mentioned above. For most persons who engage in these occupations their mathematical requirements will be satisfied by the complete high school course in mathematics. On the other hand, it is of distinct advantage that these professions should include among their members some who are trained in more advanced mathematics.

In the business world of Commerce and Finance computational arithmetic and the mathematics of finance have constant application. An acquaintance with calculus and with statistics is increasingly desirable. For a career in Public Accountancy the mathematical requirements are much the same.

Men who have participated in the armed services will

need no reminder of the importance of mathematics in Navigation – of Sea and Air and in Military and Naval Science.

The natural and social sciences make increasing use of mathematics. While the Biological and Geological Sciences are not yet considered exact sciences, there are branches of these subjects which use mathematical methods. Indeed it is becoming more and more important that a number of persons engaged in these sciences should have a specialized training in mathematics. Economics and Social Sciences make contact with mathematics in the realm of statistics and also in the solution of other problems which can be stated with mathematical exactness. In the investigation of some problems in economics, mathematics of the most advanced character has been brought into use.

The professions of Medicine, Dentistry, Pharmacy, Nursing, and Law, although they do not lean heavily on mathematics, benefit much from its study. The ability to analyze a mathematical problem should, with proper teaching, make a contribution to the diagnosis of disease. Again, practice in the logic of mathematics should be a valuable training in the formulation of legal arguments.

FUNCTIONAL COMPETENCE IN MATHEMATICS

For citizens who do not enter the professions referred to above, an important question is that of the minimum mathematical needs for effective citizenship in a modern democratic society.

Some light is thrown on this question by recalling the fact that mathematics arose in response to human needs. As soon as men began asking the questions How much? and How many?, numbers were needed. Primitive man, to be sure, required little mathematical equipment; a few whole numbers satisfied his needs. The growth and increasing complexity of civilization opening vast new areas of science, was reflected in the development of mathematics. Today we are witnessing scientific achievements which would have been impossible without mathematics and which were unheard of one or two generations ago. Almost all citizens

are now required to understand and to operate machines and instruments, an intelligent use of which requires a deeper knowledge of mathematics than our fathers needed.

During the war years, when thousands of citizens had to acquire mathematical information and skill in the interests of national defense, a careful study of minimum mathematical needs was made for the United States Army. Some 550 army jobs, most of which have civilian counterparts, were subsequently studied and their requirements used as a basis for defining minimum mathematical needs for citizenship. This definition of "functional competence in mathematics", which is partially outlined in the following paragraphs, is well worth study; for many students it is an answer to the question, "How much mathematics do I need to know?" It is true that there have been many competent citizens in the past with less mathematical knowledge than that outlined below. In the opinion of able experts, however, this outline indicates the knowledge of mathematics which will, in the future, be essential for effective participation in a modern democratic society. It will be observed that most of the topics to be mentioned are included in the curricula of high schools to the end of grade ten.

The phrase "functional competence in mathematics", which has gained some currency in present-day writing, implies an understanding of the subject which will make the person competent to make such use of mathematics as he is likely to need in the ordinary pursuits of life.

To begin with, every citizen should know the basic operations of arithmetic so that he can use whole numbers, common and decimal fractions, and per cents, with accuracy and ease. In these operations he should form the habit of estimating answers in advance and verifying them when found. Almost everyone needs to be able to make measurements in various units, to understand the possible errors in these measurements, and to use properly in computation numbers obtained from measurements. He should understand the distinction between positive and negative numbers and be able to use them.

Life situations furnish innumerable examples of quantities related so that the value of one depends on the value

of another: the amount of gasoline consumed depends on the speed of travel, the amount of postage depends on the weight of the parcel, the cost depends on the number of articles bought, and so on.

For dealing with problems arising in this area of relationships, mathematics has effective tools. Every citizen needs to be able to use tables of values, to draw and interpret graphs of various kinds, and to use simple formulas. This implies familiarity with the use of letters to represent numbers and with simple equations. The graph and the formula have become commonplace tools in everyday affairs. Newspapers and magazines make frequent use of graphs to illustrate the manner in which one quantity changes with another; graphs of price and wage increase and of changes in the cost of living index have become almost as familiar as the temperature charts used by nurses. Formulas, as well as being indispensable in any branch of technology, also play their part on the farm and in the home. They serve the farmer when he builds his silos and bins and the housewife when she uses her recipes or goes shopping; to say that many farmers and housewives do not use formulas is not to say that they do not need them. How does the capacity of a silo change with its height? With its diameter? In buying circular cookies how should the price change with the diameter? How much is saved in buying oranges by the dozen or by the crate instead of singly? If the recipe is designated to serve five, what adjustment makes it serve eight? How does the size of an egg depend on its length? In what way does a thick skin alter the value of an orange? Such questions provide a proper field for the use of formulas.

Even a superficial inspection of the structures and machines about him points to the fact that the competent citizen needs acquaintance with geometry. Angles, points, lines, triangles, rectangles, circles, prisms, cones, cylinders, and spheres are part of the experience of nearly everyone. The simple constructions with ruler and compasses of the more common plane figures of geometry are helpful in many trades and professions. Scale drawings, requiring a knowledge of ratio along with geometrical ideas, provide a meeting-ground for arithmetic, geometry, and algebra. For-

mulas for areas and volumes of common solids such as the cylinder and sphere, and the formula for Pythagoras for the right triangle should be included among the minimum needs for ordinary competence in mathematics

For other essentials for mathematical competence the reader is referred to the report of the Commission referred to above: Guidance Pamphlet in Mathematics for High School students.

THE CONTRIBUTION OF MATHEMATICS TO REASONING ABOUT OTHER THINGS

The question of whether the study of mathematics helps one to reason correctly about other things has wide implications for teachers of mathematics. It has, in the past, been answered both in the affirmative and in the negative and the answers have been used as arguments both for and against mathematics. As a result of experiments and observation of results, the smoke of controversy has gradually lifted and some positive conclusions can now be put forward.

Many investigations have been made of the possibility of transfer of training from reasoning in mathematics to reasoning in non-mathematical situations. Opinion today is that the likelihood of such transfer is slight or non-existent if no conscious effort is made to direct the mind of the student to extend the principles of logic acquired in mathematics to these other fields. But once the teacher is aware of the desired attainment, and once a constructive attempt is made to achieve the objective, satisfactory results may be expected.

An investigation of this question, together with experimental evidence, has been presented by H. P. Fawcett in the 13th yearbook of the National Council of Teachers of Mathematics. In this investigation, entitled The Nature of Proof, the following four conclusions were drawn, of which the third is particularly pertinent to our present discussion.

1) Mathematical method illustrated by a small number of theorems yields a control of the subject matter of geometry at least equal to that obtained from the usual course.

2) By following the procedures outlined, it is possible to improve the reflective thinking of secondary school pupils.

3) This improvement in the pupil's ability is general in character and transfers to a variety of situations.

4) If demonstrative geometry is presented in a formal manner, without being related to other situations, little improvement results in the reflective thinking of the pupils.

THE AESTHETIC AND CULTURAL ASPECTS OF MATHEMATICS

In the previous sections, many reasons have been shown for the study of mathematics. It remains to consider one other possibility, namely, that we might study it for no reason at all, except to obtain pleasure, stimulation, and insight into the world around us. The fact is that there are two sides to mathematics. It is, as we have already seen, a scientific method for solving problems in great variety, and it is a free flight of the imagination, taking these as a starting point and going far beyond them. Some particular problem presents itself and is solved; mathematicians then set out to collect and arrange as many related results as possible regardless of immediate usefulness. It quite often happens that after a period of time some new question arises, and that these other results are exactly what is needed for it; and this problem when solved raises others, and so the process continues.

This may be illustrated by a classical example. The ancient Greeks, having solved certain problems in land surveying, had their curiosity aroused regarding the properties of the straight line and circle. Having investigated these loci, they continued with the parabola, ellipse, hyperbola, and other curves, not dreaming that, centuries later, their work would be the foundation of new discoveries in astronomy, when Kepler (1609) showed that the ellipse is the curve followed by a planet as it goes around the sun. A closer study of this situation raised a host of new questions, which in turn gave rise to new branches of mathematics, and the process is still continuing at the present day.

Thus it happens that our modern civilization depends as much on mathematics as it does on chemistry, for example. The evidence of achievement in chemistry is all around us, so that anyone with normal curiosity would wish to study at least the elements of chemistry in order to have some idea of its processes, whether or not chemistry is thought of as a career. It is the same with mathematics but this requires further explanation, as it could not be guessed from the contents of high school mathematics alone. It is not the algebra and geometry of high school that affect the modern world so much as other branches of mathematics which are rooted in them.

Fundamentally mathematics is concerned with clear thinking rather than with solving specific problems. One feature of present-day mathematics is its concern with the study of axioms and their consequences and with the close scrutiny of fundamental ideas such as point, line, and number. On the imaginative side, mention should be made of recreational mathematics, which has to do with games, puzzles, and interesting questions of many kinds. They have formed the well-spring of much of the mathematical interest of the human race, from ancient times does to our own.

Those who are engaged in developing mathematics in advance of current practical needs regard it as a free creation of the human mind, somewhat like music or literature, or even as a game or sport. Nobody stops in the middle of a football game to ask what is the practical value of football. In the same way, mathematics may be regarded as a game to occupy leisure hours, or as a field in which to display one's skill at discovering new results or new methods. It has already been noted that this game is being played vigorously at the present day, and in scores of journals throughout the world new results are published every month. Little thought is taken of practical applications, the only questions asked being "Is it true?" and "Is it interesting?".

It should be said finally that, whatever reason one has for studying mathematics, the most effective method is to study it for its own sake. A person who refused to study any topic in mathematics until he was shown a specific application for it in some other field would make very little progress.

From those who would be her devotees, mathematics demands much concentration on manipulative details, just as music demands finger exercises and practising of scales. The manipulation, however, is not the aim of mathematics any more than the playing of scales is the aim of music. In his mastery of mathematics, a student will often experience a thrill of imagination and an elevation of spirit not unlike those resulting from a mastery of music. A distinguished mathematician and philosopher, Bertrand Russell, has expressed much the same idea: "Mathematics possesses not only truth, but supreme beauty — a beauty cold and austere, like that of sculpture, without appeal to any part of our weaker nature, sublimely pure, and capable of a stern perfection such as only the greatest art can show".

A prominent official was asked to deliver an after-dinner speech at the banquet recently held in Cambridge, Mass., for the Mathematicians at the International Congress.

"What do you wish me to speak about?" he asked.

"About five minutes," was the answer.

ON THE SET OF LEGS OF A HORSE

by Marlow Sholander
Washington University

In a recent issue of this Journal [1] there appeared the question "How many legs has a horse?", and the answer "Twelve; two in front, two behind, two on each side, and one in each corner." The enumerator overlooks the existence of bottom legs, outside legs, and so on. It is the purpose of this paper to give the correct answer to this fundamental problem. We prove that the number is infinite; more precisely, that the set of legs has the power of the continuum.

This answer may come as a surprise to the casual observer but it was not unanticipated. There is some reason to believe that the originator of the word "equator" [from "equus" meaning "horse" and "ater" meaning "dark"] was attempting to announce this discovery in the subtle fashion peculiar to his period. Again, Stephen Leacock [2] writes of someone who jumped on his horse and rode madly off in all directions. This, of course, would be impossible with a finite-legged horse. One authority on horseplay [3] has even made an attempt at a proof. He starts with the assumption that the number of legs, y, of a horse is a non-decreasing function of its age, x (The variable x is, of course, determined by the inspection of the horse's teeth). He then seeks to show that y is unbounded in any finite interval of x. However his proofs invariably begin "Given a horse..." and he unfortunately overlooks that he has thus made x indeterminite since gift horses are not to be looked in the mouth.

[1] Numbers in brackets refer to the bibliography at the end of the paper.

We offer below several proofs of the fundamental result.[2] First let us note that the answer is not as unreasonable as it may first appear. Assume that the number of legs, n, of a horse is finite. From [1], we have n 4. Even the most skeptical will grant this (n) is an odd number of legs for a horse. But, in contradiction, we have that n is even since each horse has a plane of symmetry which contains no legs. If an argument of a direct type is desired, the reader will recall that n is infinite if and only if the set of legs can be placed in one-one correspondence with a proper subset of itself. But if each leg corresponds to itself, we have such a correspondence — if the set of legs of a horse is improper, how does one account for the disappearance of the horse-blanket?

Perhaps the simplest rigorous proof can be made by using the well-kncwn schachprinzip or "box principle".

Proof I: Assume that the number of legs, n, is finite. As the horse remains standing, place his legs in n-1 boxes, so that at most one leg is found in each of the boxes. By the box principle, at least one leg is left over. But this is a contradiction since throughout the process each leg was left underneath.

Proof II: Suppose that there are some horses with a finite number and some with an infinite number of legs. This would clearly require the existence in every town of one each of two kinds of veterinarians, i. e., the existence of a paradox. Thus it is sufficient to show that at least one horse has an infinite number of legs. We prove more — that given any two horses, at least one has an infinite number of legs. Assume that all finite-legged horses have been colored red and all infinite-legged horses blue. Consider two horses. We may assume the first horse is red. If the second horse is blue, the theorem is proved. If the second horse is red, that's a horse of a different color. But in this case we have an immediate contradiction.

Proof III: We prove by induction that the number of legs, n, of a horse is greater than a positive integer m, for all m.

[2] One remark is in order. Here and there a wording may seem ambiguous. In these cases, the reader is to interpret the words in their horse sense.

By [1], this holds for $m = 1, 2, \ldots, 11$. Assume it holds for $m = k \geq 11$, i.e., assume the number of legs exceeds k. If the reader grants this, he will surely grant that n exceeds $k + 1$. If, on the other hand, he feels this is too too many, we have $n = k + 2$. Thus, in either case, the statement holds for $m = k + 1$.

Once we grant that a horse had an infinite number of legs we suspect the set is uncountable for the simple reason that people who have tried to count the set usually obtain 4 as an answer. This suspicion is confirmed in the following proof that the set of legs has the cardinal number of the continuum.

Proof IV: By definition, c, the cardinal number of the continuum, is the number of points in a lion. We wish to prove $n = c$. Let h be the number of points in a horse. Clearly $n \leq h$ and, from the case of a hungry lion and a small horse, we see also that $h \leq c$. It remains to be proved that $c \leq n$, i. e., that the points of a lion may be placed in one-many correspondence with the set of legs of a horse. But, trivially, we may have a one-many correspondence from a subset of the points of a lion to the set of legs of the horse. Regardless of which such correspondence we choose to consider, there is surely no point in a lion without a leg. Hence the correspondence considered is the one needed to complete the proof.

The author has as yet not had time to develop the innumerable consequence of this result. For one thing, it is clear that we have been misguided in shooting a horse when he breaks a leg since each leg has as its horsepower at most $\lim_{n \to \infty} 1/n$. It would be of interest also to generalize the result from horses to, say, the best cattle — those from which we get prime legs of beef. Those who make it a point to keep abreast of developments in foreign research inform the author that an Alexandrian geometer, Euclid, has already made progress in this direction. In closing, the author expresses regret that lack of space prevented his giving Proof V, perhaps the most interesting proof of all. This proof is based on an argument which makes use of the neigh-borhoods of a Horsedauf Space.

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1. Pi Mu Epsilon Journal, vol. 1 (1949) p. 24.

2. Stephen Leacock, "Gertrude the Governess, or Simple Seventeen", The Leacock Roudabout, New York, 1946.

3. N. Baerbaki, "Die Theorie und Anwendung des wiehernden Gelächters", Appendix II.

Note: N. Baerbaki is not to be confused with his distinguished French cousin N. Bourbaki. The former, in reply to a letter asking:

A. When his manuscript is to be printed,
B. If his last name is pronounced "barebacky",
C. What his first name is,

cabled, from his present address in eastern Germany, as answer (presumably only to the third question) the single word "Nichevo".

When the tall inductee presented himself for a physical examination and was asked his height by the examining sergeant the inductee promptly answered,

"I am five feet, seventeen and one half inches tall, Sir."

"You can't kid me, Slim. I know you are more than six feet," snapped the sergeant.

PROBLEM DEPARTMENT

This department welcomes problems believed to be new and, as a rule, demanding no greater ability in problem solving than that of the average member of the Fraternity, but occasionally we shall publish problems that should challenge the ability of the advanced undergraduate and/or candidate for the master's degree. Solutions of these problems should be submitted on separate, signed sheets within five months after publication. Address all communications concerning problems to the Editor.

21. Proposed by Mary Anice Seybold, North Central College

A Christmas Problem

In the following long division, each letter represents one and only one number and each number is represented throughout by the same letter. There are no unconventional arrangements of digits. To find my Christmas wish for readers of Pi Mu Epsilon Journal, establish the correspondence of letters to numbers and arrange them in the order 1, 2, 3, . . . , 0. Prove the solution is unique.

```
          F Y
    ------------
J S L ) F U M X
        F O F
        -----
          Y F X
          Y J M
          -----
            O A
```

22. Proposed by Don A. Gorsline, University of Oklahoma

(Note. This problem appeared on page six of the Pi Mu Epsilon initiation banquet program of the Oklahoma Alpha chapter, and because it proved interesting on that occasion we are printing it here.)

Each letter in the following addition problem represents a unique digit. Furthermore $L^2 = L$ and $M^2 = T$. Establish the correspondence of letters to digits.

NOTE

PIMU

EPSILON

EPITOME

22. Proposed by Roy Dubisch, Fresno State College

If in a triangle with sides a, b and c we have $c \geq b$, $c \geq a$, find k such that $c^2 = ka^2 + b^2$.

24. Proposed by Paul J. Schillo, University of Buffalo

If θ_n is the angle opposite the side of length $4n^2$ in the integer right triangle with sides $4n^2$, $4n^4 - 1$, $4n^4 + 1$, where n is any positive integer, show that

$$\lim_{n \to \infty} \sum_{i=1}^{n} \theta_i \text{ is a right angle.}$$

SOLUTIONS

12. Proposed by C. O. Oakley, Haverford College

The Census Enumerator Problem

A census enumerator goes to a house and notes the number of the house. The man who answers the door bell

gives the enumerator his age and adds that there are three other members of his household. But he refuses to give the ages of the other three. Instead he says, "The product of their ages is 1296 and the sum is equal to the house number." The enumerator, after some computing, says, "I need some more information. Are you the oldest member of the household?" The man replied, "Yes." The enumerator now has enough information to compute the ages of the other three and so have you.

Solution by C. S. Goodrum, Leo Moser and J. H. Wahab, University of North Carolina

The only factorizations of 1296 into three factors, having the same sum are 1·18·72 and 2·8·81. For the age of A, the man who answers the doorbell, to be a determining factor the other ages must be 1, 18 and 72.

The equations used in the solution of the problem are:

$$(1)\ abc = 1296 \quad \text{and} \quad (2)\ a + b + c = n$$

where n is the house number. Any solution in integers for these two equations is unique unless n = 91, in which case there are the two sets of factors as given above. This can be noted by determining all possible sets (a, b, c) satisfying (1).

Also solved by W. R. Ransom as well as the proposer C. O. Oakley,

19. Proposed by E. P. Starke, Rutgers University

Given two polynomials of degree n,

$$f(x) \equiv a_0x^n + a_1x^{n-1} + \ldots + a_n,$$

$$g(x) \equiv b_0x^n + b_1x^{n-1} + \ldots + b_n,$$

and n + 1 arbitrary constants $k_1, \ldots, k_{n+1}$, not necessarily distinct; if

$$f(k_1) = g(k_1), \quad f'(k_2) = g'(k_2), \quad f''(k_3) = g''(k_3), \ldots,$$

$$f^{(n)}(k_{n+1}) = g^{(n)}(k_{n+1}), \quad \text{then } f(x) = g(x) \text{ identically.}$$

Solution by James J. Gehrig, University of Wisconsin

Differentiate both f(x) and g(x) n times:

$$f(x) = a_0x^n + a_1x^{n-1} + a_2x^{n-2} + \ldots + a_{n-3}x^3 + a_{n-2}x^2 + a_{n-1}x + a_n$$

$$f'(x) = na_0x^{n-1} + (n-1)a_1x^{n-2} + \ldots + 3a_{n-3}x^2 + 2a_{n-2}x + a_{n-1}$$

$$f''(x) = n(n-1)a_0x^{n-2} + \ldots + 3\cdot 2a_{n-3}x + 2\cdot 1a_{n-2}$$

$$f'''(x) = n(n-1)(n-2)a_0x^{n-3} + \ldots + 3\cdot 2\cdot 1a_{n-3}$$

$$\vdots$$

$$f^{(n-1)}(x) = n(n-1)(n-2)\ldots 3\cdot 2a_0x + (n-1)!\,a_1$$

$$f^{(n)}(x) = n!a_0$$

Similarly,

$$g(x) = b_0x^n + b_1x^{n-1} + \ldots + b_{n-2}x^2 + b_{n-1}x + b_n$$

$$g'(x) = nb_0x^{n-1} + \ldots + 2b_{n-2}x + b_{n-1}$$

$$g''(x) = n(n-1)b_0x^{n-2} + \ldots + 2!\,b_{n-2}$$

$$\vdots$$

$$g^{(n-1)}(x) = n(n-1)(n-2)\ldots 3\cdot 2\,b_0x + (n-1)!\,b_1$$

$$g^{(n)}(x) = n!\,b_0.$$

By our hypothesis

$$f^{(n)}(k_{n+1}) = g^{(n)}(k_{n+1}); \quad \text{that is, } n!a_0 = n!b_0$$

$$\therefore \quad a_0 = b_0.$$

Also

$$f^{(n-1)}(k_n) = g^{(n-1)}(k_n), \quad \text{that is}$$

$$n(n-1)(n-2)\cdots 3\cdot 2a_0k_n+(n-1)!a_1=n(n-1)(n-2)\cdots 3\cdot 2a_0k_n+(n-1)!b_1$$

$$\therefore\ a_1 = b_1$$

Similarly

$$a_j = b_j, \quad j = 0, 1, 2, \ldots, n.$$

Hence we have shown that

$$f(x) = g(x) \quad \text{identically.}$$

Also solved by H. Pitt and S. Gartenhaus.

Have you seen this one?

$$(\tfrac{1}{2})^3 < (\tfrac{1}{2})^2.$$

Taking the logarithm to the base $\frac{1}{2}$ of each member of the above inequality, we write

$$3\log_{\frac{1}{2}}(\tfrac{1}{2}) < 2\log_{\frac{1}{2}}(\tfrac{1}{2}).$$

But $\log_b b = 1$. Therefore

$$3 < 2.$$

REPORTS TO THE CHAPTERS

(Send reports to Ruth W. Stokes, 15 Smith Hall, Syracuse University, Syracuse 10, New York.)

EDITOR'S NOTE. According to Article VI Section 3 of the Constitution: "The Secretary shall keep account of all meetings and transactions of the chapter and, before the close of the academic year, shall send to the Secretary-General and to the Director-General, an annual report of the chapter activities including programs of meetings, results of elections, etc." The Secretary-General now suggests that an additional copy of the annual report of each chapter be sent to the editor of the Pi Mu Epsilon Journal. Besides the information listed above we are especially interested in learning what the chapters are doing by way of competitive examinations, medals, prizes and scholarships. These annual reports will be published in the chronological order in which they are received.

Alpha of Oklahoma, University of Oklahoma

The first meeting of the academic year, 1949-1950, was held on October 6. The following officers were elected: Director, Mr. Don A. Gorsline; Vice-Director, Walter C. Brown; Secretary-Treasurer, Rose M. Pratt.

The activities included business, social and regular meetings at which the following talks were given:

"Lion chasing" by Donald Dubois

"The construction of the real number system" by Gene Levy

"The application of mathematics to engineering problems" by Professor J. Ray Matlock

"Mathematics and astronomy" by Professor J. O. Hassler

"Some aspects of mathematics related to naval sciences" by Forrest Grogan.

Beta of North Carolina, University of North Carolina

Under the chairmanship of Natheniel Macon, the program committee arranged the following programs:

"Dirichlet's principle of compartments" by Leo Moser

"Homotopy and some fixed-point theorems" by Professor W. R. Mann

"Codes and ciphers" by Paul Minton

"Mathematics for the non-professional" by John W. McReynolds (Political Science and Journalism Departments)

"Matrices with integer elements" by Alec Davis

"The actuarial profession" by Mr. C. H. Benson, Vice-President Pilot Life Insurance Company

"Collineation groups and the subgeometries of projective geometries" by Aubrey Payne.

As an additional part of several programs, a problem section was conducted by Leo Moser, well-known in the problem section of the MONTHLY.

A short "coffee-session" was held after most of the programs during the year. Two picnics and a party made up the rest of the social program; the party was notable for a jazz band concert involving a trumpet, trombone and guitar played by members.

Officers elected for 1950-1951: Director, Bryan Gresham; Vice-Director, George Carow; Secretary, Alex Davis; Treasurer, Ed Pellicciaro; Faculty Adviser, Professor J. W. Lasley; Permanent Secretary, Professor W. M. Whyburn.

Alpha of Louisiana, Louisiana State University

The first meeting of the chapter, held October 26, 1949, was organizational and included election of officers. Officers elected for the year were: President, Marion Smith; Vice-President, Rodger Richardson; Secretary, Alice Pecot;

Treasurer, Agnes Schertz; Faculty adviser and Corresponding Secretary, Professor Houston T. Karnes.

The following papers were presented during the year:

"Newton's law of gravity" by Dr. F. A. Rickey

"Statistical analysis of data" by Dr. Donald Billings

"Statistical quality control" by Mr. M. C. Wicht

"Length and area" by Dr. H. L. Smith

"Transfinite numbers" by N. E. Rutt

"Conservation of systems in phase space" by Mr. Ernest Ikenberry

"Mathematics as applied to chemistry" by Dr. Olen A. Nance.

The Pi Mu Epsilon Lectures were given this year by Dr. H. S. Householder, Head — Mathematics Section of Oak Ridge National Laboratory. The subjects for the two lectures which he delivered were:

"The relation of mathematics to the sciences" and

"Statistics and the computer's art"

Five new volumes were added to the Pi Mu Epsilon Shelf in the Mathematics Library

Beta of Pennsylvania, Bucknell University

The activities of the Pennsylvania Beta chapter for the academic year 1949-1950 included business, social and regular meetings with formal talks or papers. The first two meetings were organization. Officers elected for the academic year 1949-1950 were: Director, Donald G. Ohl; Vice-Director, Weston H. Jenkins; Secretary, Andrew W. Mathieson; Treasurer, Jack R. Linaberry. Talks and papers presented were:

"The binomial theorem" by James A. Bortner

"Group theory" by Donald G. Ohl

"Practical equation solution" by Edwin A. Irland

"Applications of the finite calculus" by Evan H. Boden

For the final meeting, May 17, 1950, there was held a picnic and election of officers for the ensuing year. These officers for 1950-1951 are: Director, John W. Sprout, Vice-Director, Frederick R. Stauffer; Secretary, Charlotte D. Stratton; Treasurer, Ralph E. Jones, Jr.

Beta of Colorado, University of Denver

The Colorado Beta chapter was installed on April 27, 1950, by Director General C. C. MacDuffee. Installation was held following a banquet with twenty-five charter members and ten additional members being initiated.

The chapter has held only one meeting, May 16, 1950, with fifteen members in attendance. It was a business meeting with no speaker.

Alpha of Missouri, University of Missouri

Forty-eight members were initiated during the year. Programs of interest were the following:

"Mathematics among the Babylonians" by Professor Herman Betz.

"Some Diophantine Problems" by Professor W. R. Utz

"Coverage theorems" by Professor L. M. Blumenthal

"Examples of Non-Linear Vibrations" by Professor George Ewing.

"Mechanism of calculating machines" by Professor D. L. Naidelich

"Mathematics curricula in the university" by Professor Paul Burcham.

The annual banquet, held on May 12, was the high light of the year. Ninety-two members and guests were present. Professor Herman Betz ably served as toastmaster, calling on the following persons for short talks, Professor George Ewing, Miss Mary Cummings, Sidney Minick, Bill Nichols and David Neebe.

Officers for 1950-1951 are: President, David Neebe; Vice-President, Richard Wood; Secretary, Raymond Poyner; Treasurer, Aldo Linsenbardt; Faculty Adviser, Miss Mary Cummings.

Alpha of Colorado, University of Colorado

The Colorado Alpha chapter held twelve regular meetings during the academic year 1949-1950. At some of the

meetings a group of pledges had charge of the program and each gave a short talk on some topic of interest such as: Types of simple harmonic motion, different kinds of time and methods of locating stars by use of these times, star constellations, famous theorems, and the like. At other meetings the following papers were presented:

"Soap films — How minimum surface areas are determined with the use of various wire forms" by Dr. J. R. Britton.

"Application of fundamental mathematics to practical problems" by Dr. William A. Rense

"The Electronic Integrating Machine" by Mr. Robert E. Glover of the Bureau of Reclamation

"Topology" by Dr. Burton W. Jones

"Money Types of paper money from different countries" by Dr. Frederick Rohrman of the Engineering Experiment Station

"Recursion relations" by Mr. Burrowes Hunt

"Analytic number theory" by Dr. S. Chowla, University of Kansas

"Modern architecture and modern art" by Mr. Alden F. Megrew (This was a social meeting — quarterly banquet and a non-mathematics speaker was selected because of the large numbers of guests attending the banquets.)

Alpha of California, University of California at Los Angeles

The activities of the California Alpha chapter for the year 1949-1950, were briefly summerized by the secretary as follows:

The chapter held eight meetings during the year. Of these two were purely business meetings, two were for the purpose of initiating new members, and four had speakers or other programs. The latter were as follows:

"Summability and Tauberian theorems" by Dr. G. Milton Wing.

"The theory of plasticity" by Dr. Philip G. Hodge

"Unified field theory" by Dr. Ernest G. Straus.

The Putnam Prize Examination: solutions were presented

by the team composed of John Kuhns, Geneveve Lopez, John Harrington, William Sibley and William Stalder.

Alpha of Iowa, Iowa State College

The Iowa Alpha chapter held three regular meetings, one each quarter, during the academic year 1949-1950. At the fall and spring meetings, besides mathematical talks or papers, the program included election of candidates for membership in the fraternity. Talks on the following topics were given:

"Education in India, China and Russia" by Mr. Rahman, Mr. Chu and Dr. Thielman, respectively

"The solution of cubic and quartic equations" by Arlin Fayerherm, graduate student

"The elastic curve of a simple beam under impact" by W. D. Clingman of the T. and A. M. Department.

The approximate attendance at these meetings was 25 and consisted of both students and faculty.

The fall and spring banquets were an important part of the year's program. They were held immediately after fall and spring initiation and were in honor of the initiates. Usually about 100 old and new members were present. The program at such times usually includes a skit put on by recent pledges.

Officers who served during the year were: Director, Mildred Pretnall; Vice-Director, Jane Lloyd; Secretary, Eleanor Johns; Treasurer, Ted Willoughby (succeeded in January by Karl Conrad).

Officers elected for 1950-1951 are: Director, Eleanor Johns; Vice-Director, Richard Johnson; Secretary, Ella Mae Robertson; Treasurer, Leslie Gates; Faculty Adviser, Mr. Ralph M. Robinson.

Alpha of Montana, Montana State University

Papers presented at meetings during the academic year 1949-1950 were the following:

"Number theory" by Dr. H. Chatland

"Fun with mathematics" by Dr. H. Chatland (joint meeting with the Mathematics Club)

"Philosophy of mathematics" by Dr. T. G. Ostrom

"Thermo-Dynamics" by Dr. Lory of the chemistry department

"Accomplishments made in physics during the first half of the 20th century" by Dr. C. R. Jeppesen of the physics department.

Daniel Coffey's presentation of his Master's thesis "Pursuit Curve Characteristics — mathematics as an aid to Air Force gunnery" by Mr. John Peterson.

The annual banquet was held on March 24, with Director John Peterson as toastmaster. The initiates of the current year were given certificates of membership at that time.

Officers elected for 1950-1951: Director, Merton Robertson; Vice-Director, Evan Rempel; Secretary, Marybelle Fry; Treasurer, Dr. T. G. Ostrom.

Alpha of Kansas, University of Kansas

The chapter held five meetings during the year 1949-1950, three of which were business meetings, two social including the annual banquet honoring the new members.

The banquet speaker was Director General C. C. MacDuffee, who spoke to the chapter on the place of honor societies in our educational system.

Following the address, Professor MacDuffee answered questions from the floor concerning Pi Mu Epsilon, its Journal, and the amendments to the Constitution that had been considered at the March meeting.

MEDALS, PRIZES AND SCHOLARSHIPS

EDITOR'S NOTE. Each chapter will undoubtedly be interested in learning what other chapters are doing along the line of prize competitions. So the editor makes the request that chapters offering prizes, scholarships, or other awards, write up their plans for such contests and submit them for publication in this journal.

"The annual, university-wide competitive mathematics examination was given April 15. Ronald Smith was first place winner and T. L. McElhaney was second place winner. First place winner will receive $10 in mathematical books, and second place winner will receive $5 in mathematical books. Both are honored guests at the spring banquet."

— Oklahoma Alpha Chapter.

"The Senior Award was won by Miss Katherine Wood Rollins, of Shreveport, Louisiana.

"The Freshman Award was won by Mr. Von Be Luong of Wietnam, Indo China."

— Louisiana Alpha Chapter.

"The 'Problem of the Month' was posted at the beginning of each month, and a one dollar prize was awarded to the first person submitting a contest solution.

"Winners in the annual calculus competition were: Delbert W. Clavert, first prize $15.00; Harley M. Newsom, second prize $10.00; and Charles Floyd, Third prize $5.00."

— Missouri Alpha Chapter.

"The chapter sponsors an annual contest in calculus.

First prize went this year to Leonard Ross, second prize to Seymour Singer and Jack Sandweiss."

— California Alpha Chapter.

"Each spring at Honors' Day the Pi Mu Epsilon Award in mathematics is given to an outstanding student who has completed sophomore calculus. This year the award went to John F. Pauls."

— Iowa Alpha Chapter.

"The chapter started out the academic year 1949-1950 by celebrating the tenth anniversary of the awarding of Pi Mu Epsilon entrance prizes. These are given annually to the three freshmen from Montana High Schools who place highest on an examination in Mathematics. This year the awards went to Jo Anne Grundstrom, twenty-five dollars; J. Hollis McCrea, Jr., fifteen dollars; and Robert J. McRae, ten dollars."

— Montana Alpha Chapter.

"The chapter sponsors an annual competition, the winner in which receives the Bob McAnich award, it being named after a deceased chapter president. The competition is an examination on differential calculus, and the award given is decided by a committee each year, the value of which is approximately twenty dollars."

— Arkansas Alpha Chapter.

"A mathematics prize of $10 was awarded to Frank Gagliuso, the freshman receiving the highest grade in his mathematics courses."

— New Hampshire Alpha Chapter.

"Cooperating with the Department of Mathematics, each year the chapter selects the student who has done the most outstanding work in the department and nominates him for membership in the Mathematical Association of America. This year Mr. Carl Clinton Faith, a senior in the Department of Mathematics and Astronomy, was selected and his first year's dues in the Association were paid by this chapter."

— Kentucky Alpha Chapter.

NEWS AND NOTICES

Plans are being made to hold a meeting of Pi Mu Epsilon representatives at the University of Florida, Gainesville, Florida, on Friday, December 29, 1950. This is in accordance with Article V, Section 7 of the Constitution. This meeting will be held during the same week in which the American Mathematical Society, the Mathematical Association of America and the National Council of Teachers of Mathematics are holding meetings at the University of Florida.

Professor James Sutherland Frame, Chairman of the Mathematics Department at Michigan State College and Associate Editor of the Pi Mu Epsilon Journal, will spend the academic year 1950-1951 at the Institute for Advanced Study, Princeton.

A letter from Anatole Beck, President of the New York Gamma chapter of Pi Mu Epsilon at Brooklyn College, makes the following request:

> We would appreciate your publication of the following item or a reasonable facsimile: The Brooklyn College MATH MIRROR, having been continuously published since 1933, lays claim to being the oldest continuously-published undergraduate mathematics journal on the North American continent. The editors would greatly appreciate receipt of any information to the contrary. Please include particulars.

The staff of editors for the Pi Mu Epsilon Journal is making plans for publishing two issues of the Journal during this present year, one in November and one in April. The Editor-in-Chief will welcome news about chapter activities, new problems proposed for solution besides solutions of

those already printed in the Journal and original papers suitable for publication.

As a result of the balloting last spring on the proposed amendments to the Constitution and By-Laws the chapters decided to increase the fee paid to the Treasurer General by each initiate, from twenty-five cents to one dollar. This change becomes effective with the calendar year 1950-1951.

Subscription rates are as follows: For members of Pi Mu Epsilon, $1.50 for two years (4 copies). For non-members, including libraries and schools, $2.00 for two years (4 copies). Back numbers are and will be available at 40 cents per copy for members and 50 cents per copy for non-members.

Paul W. Healy of Winfield, Kansas, received his Doctor of Philosophy Degree in mathematics this past summer at the University of Kentucky. He is one of Pi Mu Epsilon's alumni members, having joined the fraternity in 1937 while he was a student at Ohio State University.

EDITOR'S NOTE. The news given in the above paragraph was gleaned from a letter written by Mr. Healy last July after he had seen a copy of Number 1, Volume 1 of the Journal. He expressed an interest in our publication and asked that his name be placed on the mailing list. We offer Mr. Healy our congratulations on having earned his doctorate and we hope for him much success in the mathematical world.

News of this nature from our graduate members is always gladly received and we shall be happy to print, as far as space allows, such news in NEWS AND NOTICES whenever reported to us. We urge the members and friends of the fraternity to write us about any accomplishments and distinctions earned by the members.

INITIATES, ACADEMIC YEAR 1949-1950

ARIZONA ALPHA - University of Arizona

Robert N. Barnes
Dan A. Betlach
Barent Briesemeyer
Wilbur G. Burroughs
William M. Gemmell
Winston Gin
Tindley Hussey
Selig N. Kaplan
Herbert Lee Kyle
William S. Lovekin
D. Clinton MacKallor
Dan E. McAllister
Arve Michaelson
Louis A. Myers
Dionese Trifan
Al Wellman

ARKANSAS ALPHA - University of Arkansas

Edward Alpuente
Orville L. Bluhm
Frances H. Bogard
Robert E. Boone
Barbara Jean Campbell
Byron Crawford
James R. Doyle
Jim B. Fullerton
Dr. B. H. Gundlach
Alice Harrison
Robert D. Harrison, Jr.
Richard B. Homard
Eric F. Li
James H. London
Robert J. Lovell
Russell Lueg
Millard M. Mashburn
James T. McDonald, Jr.
Betty McGinnis
James F. Miller
John C. Miller
James R. Nelson
Omer C. North
Jess H. Olive, Jr.
Leroy E. Page
Calvin G. Patterson
Will Raines
Nathaniel T. Richmond
William C. Robinson
Stewart E. Rogers
Corley Senyard
Earl R. Souders
Luther T. Spears, Jr.
William A. Spinelli
George R. Tait
D. V. Tucker, Jr.
Bob L. Warren

CALIFORNIA ALPHA - University of California at Los Angeles

Leland H. Amaya
Harry E. Handler
Marion L. Madison
Billiana Menke

John J. Harrington
Harold D. Hutchinson
Patricia Keith
John Kelsey
Lowell J. Knudsen
Jaimee Lukken
Madeline Morabito
William Orchard-Hays
David I. Paul
Jerome A. Schnech
Roy Ira Sutton
Daniel H. Tycko

LOUISIANA ALPHA - Louisiana State University

Davie L. Alders
Lucien I. Arditi
Charles William Barnett
Fernando Bergonzoli
Frank Buckley
Robert Earl Calcote
Frank Joseph Cannatella
George Harold Cole
Joseph G. Douvillier, Jr.
George S. Gastrock
Leon E. Hagius, Jr.
C. Oscar Harbourt
Lynden B. Howell
Charles H. Kaiser, Jr.
Alcide Joseph Landry
Harold J. Laurent
Lemuel L. Leach, Jr.
Marvin Nels Lilidahl
Alvin Victor Marks
Preston S. McReynolds
Robert R. Myers
Wyema Florence Pennington
Albert F. Peterson, Jr.
Richard Reel
Robert Ray Roberts
James Elwyn Sharp
Thomas D. Shockley, Jr.
Jashua E. Stewart
Delilah Stokes
Carlton D. Strickland
B. JoAnn Thorson
James M. Turner, Jr.
Clinton Pevry Wade
Thomas C. Walachy
Jasper Arthur Welch
Ezra J. Westbrook, Jr.
Russell Whittington, Jr.

MISSOURI ALPHA - University of Missouri

Sylvia Bailey
Albert J. Bartlett
James T. Becker
Kenneth E. Buttrey
Lloyd H. Carpenter
Homer H. Clascock, Jr.
James W. Corbet
R. Craig Christie
E. H. Culp
Glenn Davis
G. J. Marieni
Ralph A. Mauller
James Meier
T. F. McEntire
R B. Miller
David J. Neebe
Harley M. Newsom
Merle E. Parmer
Raymond P. Poyner
C. H. Propster, Jr.

Harry J. Dunshee
D. J. Garnett
Lloyd Gastineau
Morton A. Golub
James M. Hassinger
Kenneth W. Heising
Ben Jaeger
Gene S. Jamison
Edwin E. Johnson
Charles E. Kelley
Max Lowery, Jr.
Thomas H. Magee
Marjorie Manley
Don W. Putnam
George L. Satterlee
Robert Simon
Ernest Smerdon
Robert L. Snider
Wallace Spracklen
Glenn Stelzer
Bill D. Swanson
William L. Trimm
James Tudor
Richard H. Turner, Jr.
Joseph Willett
James Ytell

Richard L. Ziers

MONTANA ALPHA - Montana State University

Kenneth G. Axvig
Harold Bennett
Robert L. Berggren
Daniel Coffey
Marybelle Fry
Diana Grabow
William Jameson
Frank McCoy, Jr.
Amy Muneta
Alfred J. Murray
Jean Popham
Evan Rempel
Merton Robertson
Vail Sharp
Elsie Taylor
Eva Thorne

Richard B. Wood

NEW YORK DELTA - New York University

Francis Clark
Estelle Elia
Joan Friedman
Rafael Gordon
Harold Herman
Irving Katz
Robert Kleinman
George Lenchner
Mario Meo
Ezra Newman
Kay Pollock
Eric Rau
Jack Schneps
Mordacai Schwartz
Leonard Sherry
Edwin Speigelthal
Arline Weiner
Elaine Weiss
William Wulf
Martin Zucker

DIRECTORY

of

PI MU EPSILON FRATERNITY, INC.

*

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1950-51

Director General:	Professor C. C. MacDuffee 202 North Hall University of Wisconsin Madison, Wisconsin
Vice-Director General:	Professor D. L. Holl Iowa State College Ames, Iowa
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	Professor John S. Gold Bucknell University Lewisburg, Pennsylvania
	Professor A. J Kempner Pomona College Claremont, California
	Mr. Howard C. Bennett (ex officio)
	Professor Ruth W. Stokes (ex officio)

Corresponding Secretaries

1950-1951*

(5) Alabama Alpha, 1922, University of Alabama, University, Ala.; Dr. H. S. Thurston, Box 1453, University, Alabama

(40) Arizona Alpha, 1941, University of Arizona, Tucson, Ariz.; Miss Margaret Spencer, 1300 E. 10th St., Tucson, Ariz.

(22) Arkansas Alpha, 1931, Univ. of Arkansas, Fayetteville, Ark.; Faculty Adviser: Professor S. L. Hull, Department of Math.

(12) California Alpha, 1925, Univ. of Calif. at L. A., Los Angeles 24, Calif.; Faculty Adviser: Dr. G. Milton Wing, Dept. of Math.

(19) California Beta, 1930, Univ. of California, Berkeley, Calif.; Mrs. Sophia L. McDonald, Room 453, Wheeler Hall

(33) Colorado Alpha, 1936, University of Colorado, Boulder, Colo.; Miss Carolyn M. Howe, University Women's Club

(50) Colorado Beta, 1950, University of Denver, Denver, Colo.; Miss Katherine C. Garland, Department of Mathematics

(41) Delaware Alpha, 1941, University of Delaware, Newark, Del.; Dr. G. Guthbert Webber, Department of Mathematics

(29) Georgia Alpha, 1934, University of Georgia, Athens, Georgia; Professor W. S. Beckwith, 731 Cobb St., Athens, Ga.

(7) Illinois Alpha, 1924, University of Illinois, Urbana, Illinois; Professor Echo Pepper, 1005 S. Sixth, Champaign, Illinois

(42) Illinois Beta, 1944, Northwestern University, Evanston, Ill.; Mr. Joe Naines, Department of Mathematics

(6) Iowa Alpha, 1923, Iowa State College, Ames, Iowa; Faculty Adviser: Professor Ralph M. Robinson, Department of Math.

(16) Kansas Alpha, 1928, Univ. of Kansas, Lawrence, Kansas; Professor Wealthy Babcock, Department of Mathematics

(31) Kansas Beta, 1935, Kansas State College, Manhattan, Kansas; Professor W. T. Stratton, 511 N. Sunset, Manhattan, Kans.

*Number appearing before chapter designation indicates chronological order in which charter was granted.

(49) Kansas Gamma, 1950, Univ. of Wichita, Wichita, Kansas; Professor C. B. Read, Department of Mathematics

(13) Kentucky Alpha, 1927, Univ. of Kentucky, Lexington, Ky.; Dr. Paul Boyd, Department of Mathematics

(38) Louisiana Alpha, 1939, Louisiana State Univ., Baton Rouge 3, La., Professor H. T. Karnes, Department of Mathematics

(39) Michigan Alpha, 1940, Mich. State College, East Lansing, Mich.; Dr. John Hill, 443 Grove Street, East Lansing, Mich.

(4) Missouri Alpha, 1922, Univ. of Missouri, Columbia, Mo.; Miss Mary Cummings, 201 Engineering Building

(11) Missouri Beta, 1925, Washington Univ., St. Louis 5, Missouri; Professor Jessica Young Stephens, Department of Math.

(43) Missouri Gamma, 1945, St. Louis University, St. Louis, Mo.; Professor Francis Regan, Department of Mathematics

(9) Montana Alpha, 1925, Mont. State College, Missoula, Mont.; Permanent Secretary: Prof. A. S. Merrill, 533 E. Beckwith

(15) Nebraska Alpha, 1928, Univ. of Nebraska, Lincoln, Nebr.; Faculty Adviser: Professor Wm. G. Leavitt, Dept. of Math.

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(28) New York Delta, 1933, N. Y. Univ., Washington Square, N. Y., N. Y.; Dr. Gottfried Noether, Department of Mathematics

(30) New York Epsilon, 1935, St. Lawrence Univ., Canton, N. Y.; Dr. Ruth Peters, Department of Mathematics

(24) North Carolina Alpha, 1932, Duke University, Durham, N. C.; Prof. W. W. Elliott, Box 4721, Duke Station, Durham, N. C.

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(13) Ohio Beta, 1927, Ohio Wesleyan Univ., Delaware, Ohio; Prof. Rufus Crane, 269 West William St., Delaware, Ohio

(32) Ohio Gamma, 1936, University of Toledo, Toledo, Ohio; Dr. Wayne Dancer, Department of Mathematics

(48) Ohio Delta, 1949, Miami University, Oxford, Ohio; Miss Betsy Dodd, 244 Hamilton Hall, Oxford, Ohio

(18) Oklahoma Alpha, University of Oklahoma, Norman, Okla.; Professor Dora McFarland, Department of Mathematics

(35) Oklahoma Beta, Oklahoma A. and M. Coll., Stillwater, Okla.; Professor James H. Zant, Department of Mathematics

(21) Oregon Alpha, 1931, University of Oregon, Eugene, Oregon; Dr. K. S. Ghent, Department of Mathematics

(36) Oregon Beta, 1938, Oregon State College, Corvallis, Oregon; Professor G. A. Williams, Department of Mathematics

(3) Pennsylvania Alpha, 1921, Univ. of Pa., Philadelphia 4, Pa.; Dr. R. D. Anderson, College Hall, Box 6

(8) Pennsylvania Beta, 1925, Bucknell Univ., Lewisburg, Pa.; Mr. John W. Sprout, Department of Mathematics

(17) Pennsylvania Gamma, 1929, Lehigh Univ., Bethlehem, Pa.; Professor R. R. Stoll, Department of Mathematics

(20) Pennsylvania Delta, 1930, Pa. State College, State Coll., Pa.; Mr. Walter J. Harrington, Department of Mathematics

(44) Pennsylvania Epsilon, 1947, Carnegie Inst. of Tech., Pittsburgh 13, Pa.; Professor J. B. Rosenbach, Dept. of Math.

(47) Virginia Alpha, 1948, Univ. of Richmond, Richmond, Va.; Director: Dr. C. H. Wheeler III, Department of Mathematics

(25) Washington Beta, 1932, Univ. of Washington, Seattle 5, Wash.; Dr. Edwin Hewitt, Department of Mathematics, Physics Hall

(27) Wisconsin Alpha, 1933, Marquette Univ., Milwaukee 3, Wis.; Mr. James Grundl, Department of Mathematics

(37) Wisconsin Beta, 1939, Univ. of Wisconsin, Madison 6, Wis.; Professor R. E. Fullerton, Department of Mathematics

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